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Dr. Blaxall's Report to the Local Government Board upon the Sanitary Condition and Water Supply of Burnham, Somersetshire.

George Buchanan,
Medical Department,
December 31st, 1883.

Cause of inquiry.

The present inquiry was instituted in consequence of the Local Government Board having received complaints from certain of the inhabitants of Burnham in respect of the water supply of that town, the Medical Officer of Health likewise reporting unfavourably of the same, and the Board failing to receive satisfactory information upon the subject from the local authority.

General description.

Burnham is a small watering-place covering an area of 627 acres, situated on the shore of the Bristol Channel by the mouth of the River Parrett, at the edge of a wide tract of marsh land that stretches behind the town to a distance of four or five miles, broken only by Brent Knoll, which rises abruptly from the plain about two miles to the north-east of Burnham.

The town runs north and south, and lies low and flat. It is protected from the inroads of the sea by a wall of solid masonry, which is surmounted by an esplanade at a height of 60 feet above sea level, and about 12 feet above the level of the marsh land, and which forms a pleasant drive commanding fine views of the Mendips, Quantocks, and other hills. At the north end of the town are two mineral springs, characterised respectively as sulphurous and saline or tonic. One is said to be 50 feet deep, the other from 30 to 40 feet. They were dug about 40 years ago but have been closed for the last 10 years or so.

Population.

In 1871 the population was enumerated at 1,585 persons, and the number of houses at 326; and in 1881 at 1,921 persons, and the houses at 388, showing an increase of 336 persons and 62 houses in the 10 years.

Rateable value.

The rateable value is 7,389*l*.

Geology.

The geological formation consists of alluvial clay overlaid with sand to a depth of from 4 or 5 to 12 or 13 feet.

Sanitary jurisdiction.

For health purposes the district is under the jurisdiction of a Local Board, who have appointed Dr. Fraser Medical Officer of Health, and Mr. Palmer Inspector of Nuisances (the latter appointment is of recent date). Both officers are in part paid by moneys voted by Parliament.

Byelaws.

The authority possess byelaws relating amongst other matters to the construction of new streets and houses, water-closets, and house drainage, also as to the regulation of slaughter-houses, the prevention of nuisances arising from filth, refuse, &c., &c. These byelaws were confirmed by the Home Secretary in 1870.

Sewerage and drainage.

In 1852 a plan for sewering the town was designed by Mr. Whitehead, engineer, and submitted to the General Board of Health. The scheme comprised a system of sewers having an outfall into the river a little above low-water level with intercepting tanks for the accumulation of the sewage at such times as the outlet is blocked by the tide.

The sewers are constructed of glazed pipes varying in size from 6 to 12 inches, and the joints are mostly formed of clay. The main sewer is provided with a penstock, situated just below the sea wall, and the sewage is conveyed thence in an iron sewer to the river, the outlet being protected by a flap valve. The sewers are laid at gradients varying from 1 in 17 to 1 in 170. The distance of the tanks from the penstock is 1,206 feet, with a fall of 7 feet; and that from the penstock to the outlet 750 feet.

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No provision has been made for flushing the sewers, and the only means provided for their ventilation consist of about one dozen pipes, varying in diameter from 2½ to 4 inches. The penstock is closed, as also are the tanks, but the latter are fitted with a 2½ inch pipe for ventilation purposes. The tanks, four in number, are situated at the south-east part of the town, and communicate one with the other. They are built of brick and are cemented. Three of them measure respectively 11·6″ × 11·6″ × 13 feet, and the fourth 15·6 × 13 × 13·3, having collectively a cubic capacity of 7,827 feet.

The gasworks and a dwelling-house have, with permission of the authority, been erected in the immediate vicinity of the tanks, the yard being directly over them, and the buildings being only a few feet removed from them, an arrangement prejudicial to the health of the occupants of the dwellings as well as to that of the gas company's employés. There is also risk of injury to the arches of the tanks through the heavy loads of coal which have to pass over them. In view of this danger it was found expedient some short time since to repair and strengthen the arches when the gas company complained of the inconvenience and hindrance thus occasioned to their business, threatening to hold the authority responsible for any loss they might incur. The house drains, like the sewers, are mostly composed of glazed pipes with joints of clay. They are unventilated in contravention of the byelaws. In some instances the drains from pump sinks to sewers are formed of unglazed pipes. The inlets of house drains are usually protected by tongue traps. Waste-water pipes from baths, sinks, and lavatories in the interior of lodging-houses and other dwellings are very generally in direct communication with the drains.

According to the original scheme the sewage was conveyed to the tanks, and thence to the penstock, and so on to the outlet; but within recent years sewers from new houses at the south end of the town have been laid direct to the sewer between the tanks and the penstock; while at the north end of the town a new pipe sewer in connexion with the general sewerage scheme has been substituted for an old brick sewer that discharges into a cesspool. The old sewer still remains, and the cesspool I found full of black stinking matter.

Where sewage is discharged into tidal waters, the extent of the rise and fall of the tide becomes a question of peculiar importance. Here the rise and fall is very considerable, exceeding 40 feet at spring tides, and the sewerage system is sensibly affected by it.

Whilst this inquiry was in progress Burnham was visited by an unusually high tide accompanied by a strong westerly gale, with the result that the tidal waters washed over the esplanade, flooding the town to a depth of some two or three feet, and invading the basements of several dwellings.

The tide as it rises closes the flat valve at the sewage outfall, causing the main sewer and the tanks to fill with sewage, and a consequent stoppage of the contents of the tributary sewers. In short, the sewage becomes dammed back in the sewers, a condition which is aggravated at times of heavy rainfall, when the sewage is forced out of the drain inlets at the low-lying parts of the town, such as Oxford Street, &c.

Certain of the man-holes were opened for my inspection, when I observed the sewers to contain considerable deposit of sand and mud; this was particularly the case with the South Street sewer.

The house-drains also are subject to blockage, some two or three per week being reported as blocked in various parts of the town, and two gentlemen told me that their drains being opened on this account they observed leakage at the joints, one adding that his drain was very unevenly laid.

In view of the great increase of pressure upon the air in the sewers, under certain conditions above noted, the want of due ventilation of the sewers and drains is a very serious evil, seeing that in the absence of any special provision of the kind sewer air is at such times forced out through drain-inlets in and about dwellings, to the imminent risk of danger to the health of the occupants. Throughout my inquiry I received numerous complaints of the stinks arising from drains and closets.

Excrement removal and disposal.

Excrement removal and disposal is effected by closets variously situated, some out of doors, others indoors, but all discharging into the sewers. The outdoor closets are unprovided with means for flushing, and as a consequence the pans were often found to be filthy. The indoor closets, as a rule, are placed against outside walls, with windows opening to the external air, but some of the windows are too small to secure

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efficient ventilation. The flushing cisterns are mostly filled by force pumps, with an overflow or "tell-tale pipe" over the pump sink; but in some instances they are dependent upon rainwater from the roof, the overflow being led to the soil pipe or drain. The pan of the closet is usually furnished with a "D trap" and "Container," an objectionable arrangement favouring as it does the retention of filth. The soil pipes are placed inside the dwellings, and with very few exceptions are unventilated. Upon lifting the closet valve the escape of sewer air was found to be very perceptible. Certain of the closets offer favourable channels for the introduction of sewer air into occupied rooms. Thus, one closet was met with in a bedroom, another hidden away under the stairs, whilst others occupy unwholesome positions in workshops and wash-houses.

Refuse removal.

The authority contract for the weekly removal of house refuse and as a rule this would appear to be fairly carried out, but exceptions of an aggravated character were not wanting where refuse and manure had been suffered to accumulate for a considerable time, and to the extent of two or three cart loads or more on the precincts of lodging houses and other dwellings. I was also told that certain cottages at the south end of the town were never visited by the dustman.

Slaughter-houses.

The slaughter-houses, three in number, are situated in the midst of dwellings. They are neither registered nor kept in accordance with the requirements of the bye-laws. The flooring is formed of bricks which favour lodgment in the interstices. No covered boxes are provided for the reception and removal of blood and offal. In fact one butcher admitted that the blood passed away into the sewers. The offal is boiled down for pigs that are kept on the premises; the process causing much nuisance and annoyance. I observed large accumulations of offal and manure in the yards. The neglect of the byelaws has conduced to this state of things, but even had they been enforced they are not such as are needed to ensure efficient regulation of slaughter-houses.

Crowded state of the churchyard.

The churchyard calls for special mention, it is so much overcrowded that on digging a new grave it not infrequently happens that the remains of the dead are disturbed. This condition, together with the situation of the churchyard in the vicinity of dwellings, renders the providing of a cemetery a matter which should at once engage the attention of the authority.

Water supply.

The water supply is derived entirely from local wells which are very numerous, water being obtainable at almost any spot. The wells are sunk through the sand on to, and sometimes a short distance into, the clay; their depth varying according to the thickness of the sand, viz., from 12 or 13 feet near the esplanade, to five or six feet on approaching the level of the marshes. The sides are bricked and the water is raised by means of pumps. There are two or three public wells in different streets which are somewhat freely resorted to by the people living in the vicinity. Here, as is usually the case where wells are sunk in thickly populated areas, they stand in close relation to the sewers and drains, seldom more than 10 or 12 feet, and sometimes only two or three feet, intervening. Occasionally the pump in the yard is placed against the closet, a faulty arrangement, which increases the risk of impurities finding their way along the side of the pipe into the well which is not far removed. It is obvious from the geological character of the district that the wells are mere catch basins, the impermeable clay serving to hold up the water that drains into them from the surrounding sandy soil. In summer certain of the wells are apt to get low or to run dry for a while: this applies more particularly to the shallow wells, and to those that terminate at the clay.

The character of water in wells necessarily partakes of the nature of the gathering ground, hence it follows that if this be free from pollution the rain water percolating through it will appear at the well little altered in character, and may be regarded as affording a wholesome water supply. On the other hand, suppose the surface or subsoil to be polluted, the water percolating through it will be correspondingly contaminated; a consideration that is of vital importance in connexion with the water supply of this town seeing that the wells are sunk in a soil exposed to pollution in a variety of ways, viz., by soakage from surface filth, by decaying organic matter from the overcrowded churchyard, by casual leakage from the sewers and drains which it must be remembered are in near relation to the wells, and which are moreover subject to blockage, a condition specially facilitating leakage of contents.

The immediate manner in which the wells are acted on by surface water was instanced on the occasion of the recent flooding of the town by sea-water, the wells on the following morning being so impregnated with salt that the water was not drinkable, and this condition obtained for some days and even weeks subsequently.

The wells in Oxford Street, Gas Lane, and other parts of the town are recognised as so polluted as to render the water unfit for drinking purposes, three or four gentlemen stating that they send to South Brent, a distance of two miles for all the water they require for drinking purposes, while many of the poor people complain of having to "go begging where they can" for their drinking water. A resident of the north end of the town told me that on one occasion finding the water in his well too bad to drink he opened the well when he found it traversed by a leaky drain, the course of which he then diverted two or three feet, and curiously enough he has since been content to drink the water.

During recent years samples of water from several of the wells in this town have been analysed by various chemists with the result that out of 23 samples examined, in not a single instance is unqualified approval given of the water for drinking purposes, while many are totally condemned, and one is characterised as fit for "irrigation purposes." I was told by the Medical Officer of Health that water from this same well when kept boiling gave off steam pungent with ammonia. Here I would observe that the gathering ground throughout the district being of the same geological formation, uniformity in the chemical constituents of the well water might have been anticipated, but so far from this being the case, it will be seen by reference to the Reports of the Analyses, given in the appended Tables 1 to 6, that the several samples exhibited considerable variety, and this, not only in respect of water obtained from different wells, but from one and the same well at different times, thereby pointing to some local condition polluting the soil in the vicinity of the well.

To take for example Mr. Carpenter's reports, Table 6, it is there shown that in 10 samples of water derived from different wells,—

Solids	range from	48	to	195	parts per	100,000
Chlorine in chlorides	,,	5	,,	74·00	,,	,,
Nitrogen in nitrates	,,	0·0659	,,	2·347	,,	,,
Ammonia	,,	0·000	,,	4·360	,,	,,
Albuminoid ammonia	,,	0·0010	,,	0·0400	,,	,,

Again, with regard to samples of water from the same wells at different times,—

(1.) Tables 2 and 3 contain reports of five distinct analyses of water from well No. 243, viz., four made by Dr. Alford and one by Mr. Stoddart. In the four samples solids range from 47 to 84 grains per gallon. Chlorine from 8·5 to 11·9 grains per gallon. Albuminoid ammonia from 0·06 to 0·20 parts per million. As to the remaining sample, the analysis is simply qualitative, but Mr. Stoddart unhesitatingly condemns the water.

(2.) Two samples from the well designated No. 241 in Dr. Alford's report, and No. 252 in Mr. Carpenter's report (Tables 2 and 6), show nitrogen to vary from "traces" to 1·4469 grains per gallon, ammonia from 0·000 to 0·020 parts per million; while in the one analysis "albuminoid ammonia" is given as 0·040 parts per million, and in the other analysis "ammonia from organic matter" is recorded as 0·120 parts per million.

(3.) Two samples from Mr. M.'s well or No. 259 (Tables 4 and 6). Solids vary from 37 to 46 grains per gallon, ammonia from 0·12 to 0·230 parts per million, albuminoid ammonia from 0·040 to 0·12 parts per million. From my own observation of the situation of the wells in regard to their surroundings, I have no doubt that the sewers, drains, and churchyard are greatly implicated in the pollution of the water as indicated in the analytical reports, and the dangerous character of such pollution is heightened by the fact that all the drains carry fœcal matter.

The two wells (Table 1) expressly "condemned" are in the immediate vicinity of the churchyard.

Well No. 243 is close to the drain referred to (page 2) as having been opened on account of blockage when it was found that leakage was going on at the joints.

Well No. 256 (Table 6) is not far removed from the pump which adjoins a filthy closet.

Well No. 258 is the source whence the water was obtained which on boiling is alleged to have given off steam pungent with ammonia (page 4). The well stands in near relation to the old brick sewer mentioned as discharging into a cesspool.

Well No. 259 (Tables 4 and 6), is so near a drain that Mr. Basker, the analyst, was probably right in attributing the pollution to leakage from such source.

Well No. 260 was noted by me as being in the vicinity of a drain.

It cannot be too strongly urged upon the authority that water used for drinking purposes should be above suspicion, and that this cannot be the case where it is derived from sources such as obtain at Burnham; it is, therefore, obvious that the use of the wells should be discontinued, and a wholesome water supply substituted. The question as to how this is to be effected presents some difficulty, owing to the physical character of the district and its low rateable value, but the following schemes were mentioned to me and deserve consideration, viz.,—(1) boring through the clay; (2) bringing water from Brent Knoll, or (3) entering into arrangements with the Bridgwater authority to extend their mains to Burnham, a distance of some seven or eight miles only with a gentle fall of the land towards Burnham.

With regard to the boring, it would appear that the depth of the clay is very uncertain. Mr. H., a gentleman residing in the neighbourhood and possessing a brewery in the parish, bored some 180 or 200 feet without success, and having been informed by those competent to offer an opinion that the result was doubtful he desisted, having first offered to continue the operations if the authority would join him in the expense.

In connexion with boring, the existence of the mineral springs should not be lost sight of as possibly affecting the question.

As to Brent Knoll, this hill rises to a height of about 460 feet above the level of the plain, and is of the Lower Lias formation with an outcrop of marlstone on its summit. The geological character of the rock holds out little promise of deep springs being reached, thus in all probability the yield would be derived from the surface, and as such would not be a reliable supply.

The Bridgwater scheme apparently has the advantage of promising an abundant and wholesome supply of water, desiderata which are of paramount importance and which should carry considerable weight in forming a conclusion.

With regard to the expense of the relative schemes, boring of itself would be a costly undertaking, and if successful, pumping would be necessary, a process involving continuous expense. On the other hand, if the Bridgwater mains were extended to Burnham they would have to pass through Huntspill and Highbridge, two populous places that I am informed would probably be willing to join in the scheme and so share the expense, which would cease with the first outlay as the water would pass by gravitation. These are questions for the authority to consider and determine under the advice of a skilled engineer.

Unwholesome cottages.

It should be stated that cottages in certain outlying parts of the district are very much neglected in a sanitary point of view; they are badly off for water, unprovided with drainage, and have filthy cesspit privies. This applies more particularly to cottages in Love Lane, which are dependent upon ditch water for drinking purposes.

Byelaws neglected.

The byelaws, it has been shown, are suffered to become a dead letter; those relating to slaughter-houses being specially neglected.

Inspector of Nuisances.

The Inspector of Nuisances has kept no report book, and throughout this inquiry the want of frequent and systematic inspection and supervision was apparent. He acknowledges his shortcomings in these respects and promises in future to carry out the Board's instructions.

Concluding remarks.

The inhabitants of Burnham it must be remembered are not alone concerned in the sanitary condition of their town. The public who frequent this watering place having a direct interest in it, and it is only right that they should, so far as is practicable, be assured that in such visits they are not exposing themselves to the risk of contracting preventible disease through the atmosphere of their dwellings being poisoned by sewer air and the water they drink being dangerously contaminated; a guarantee which Burnham at the present time cannot afford them.

Having regard to the character of the place as a health resort, the absence of any means for the isolation of first attacks of infectious diseases, whether imported or not, is also to be noted.

F. H. BLAXALL.

19th November 1883.

RECOMMENDATIONS.

1. The use of water from the present wells should be discontinued and under the skilled advice of an engineer wholesome water from extraneous sources should be substituted. In the distribution of such water care must be taken to protect it from the risk of contamination by sewer air or otherwise.

2. Sewers should be extended to such parts of the town as are at present unsewered. Under skilled advice the sewers should be efficiently ventilated and provided with means for flushing. Should the town extend further to the north it will be desirable to relieve the intercepting tanks by providing another outlet for the sewage. The house drains should be ventilated and trapped between the house and the sewer. Waste water pipes from sinks and baths within dwellings should be led outside and cut off over trapped inlets to drains.

3. All water closets should be provided with adequate means for flushing. They should also be efficiently ventilated, all being provided with an opening to the external air. Soil pipes should be fixed external to dwellings and should be efficiently ventilated.

Cesspit privies should as far as possible be abolished and water closets substituted. Strict supervision should be exercised by the Inspector of Nuisances to insure closets being kept in a wholesome condition.

4. Refuse and manure should not be allowed to accumulate in the vicinity of dwellings.

5. Blood and offal should be removed from slaughter-houses in closely covered boxes within 24 hours of slaughtering, and the provisions of the byelaws as to slaughter-houses should be strictly enforced.

6. The present byelaws being, in several respects, unsatisfactory, fresh byelaws in regard of the several subject matters, should be compiled on the basis of the Model Clauses issued by the Local Government Board.

It is further desirable that the lodging houses should be regulated by byelaws under section 90 of the Public Health Act, 1875, and the authority should apply for powers under that section to make byelaws for this purpose.

7. The sanitary authority should also take into consideration the desirability of making some provision for the proper isolation of first cases of infectious disease occurring in the district.

APPENDIX.

Copies of Reports of Analyses of certain samples of water from wells at Burnham, together with the names of the Chemists by whom they were made.

Table I.—Report by C. E. Cassal.

Date.	Number or Name of Well.	Grains per Gallon.			Parts per Million.		Hardness.	——
		Solids.	Nitrogen as Nitrates and Nitrites.	Chlorine.	Free Ammonia.	Ammonia from Organic matter.	Degrees.	
1879. December	House pump.	63·84	Not given	13·02	0·056	0·22	Not given.	"*Condemned.*"
	Lawn pump.	41·3	„	3·92	0·132	0·32	„	"*Condemned.*"

Table II.—Report by Dr. Alford.

1882. Mar. 28 -	241	98·0	Traces -	8·6	0·02	0·12	4	"*All impure waters, giving evidence of sewage pollution and unfit for dietetic use.*"
	242	58·8	„ -	6·9	0·01	0·16	4	
	243	72·8	Faint trace.	10·4	0·03	0·10	4	
May 13 -	*243	84·0	Traces -	11·9	0·00	0·06	6	"The '*solids*' *and* '*chlorine*' *in excess*, otherwise a good water."
Dec. 25 -	243	47·6	„ -	10·9	0·02	0·20	4	"*A bad water, polluted with sewage and unfit for dietetic use.*"
1883. April 6 -	243	56·	—	8·5	0·04	0·18	—	"*Polluted with sewage and unfit for dietetic use.*"

Table III.—Report by F. W. Stoddart.

1880. March 3 -	S. H. Well	I have made a quantitative analysis of your sample of water, and find that it is very impure from contamination by *sewage* and *impure sea-water*, and I should think was decidedly unfit for potable purposes, and would be conducive to diarrhœa and to the formation of gravel and stone. I should strongly advise you not to use the water. It contains in solution a very large quantity of *ammonia, nitrates, chlorides, lime, animal matter*, and each gallon has in solution *no less than* 80 *grains of total solids.*
July 21 -	New Well A.	I have made an analysis of each of your samples of water, with the following results. The water A. contains a very large excess of ammonia and chlorine, and is evidently in direct communication with sewage.
	†Well B.	The water B. contains a considerable excess of ammonia, nitrates, and chlorides, and is impure from indirect sewage contamination. *Neither water can be safely used for potable purposes.*

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* In consequence of the unfavourable report of the analysis of this water in March the well was cleaned out, and the water again submitted for analysis with the result above given.

† Well B. is the same well as No. 243 in Table 2.

Table IV.—Report by J. A. Basker.

Date.	Number of Well.	Grains per Gallon.		Parts per Million.		Observations.
		Solids.	Chlorine.	Free Ammonia.	Albuminoid Ammonia.	
1883. Oct. 6 -	Mr. M.'s Well.*	37·	4·7	0·12	·12	"I enclose Report on water. I believe from the amount of free and albuminoid ammonia present that there is some contamination either from surface water or a slight leakage in the sewage drain. If those matters could be looked into and remedied the water would in all probability be a fair sample and suitable for dietetic purposes."

Table V.—Report by Dugald Campbell.

Total solid matters in a gallon	74·88
Mineral matter	71·12
Volatilised matter blackening when heated	3·76
Degrees of hardness before boiling	32·0
,, ,, after ,,	22·4
Ammonia free and as salts	0·004
Do. in volatilised matter (albuminoid ammonia)	0·024
Mineral matters as under:—	
Silica	2·64
Oxide of iron and alumina	1·76
Carbonate of lime	9·60
Sulphate of lime	28·37
Nitrate of lime	5·78
Sulphate of magnesia	2·20
Chlorides of sodium and a trace of chloride of potassium	11·03
Carbonate of magnesia	6·51
Carbonate of soda	2·90
Loss in analysis	0·33
	71·12

"Mr. B.'s well at Hombush when examined was found to have a distinct yellow tinge and to be slightly turbid. It contained a slight trace of deposit consisting of sand, decayed vegetable fibre, and infusorial animalcules.

"I should on no account advise its use if it could be done without, for besides containing a very large amount of albuminoid ammonia it has a very distinct fermentative action, which it does not lose after boiling. On this account it would be a most unsafe water to use."

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* Mr. M.'s Well is the same as No. 259 referred to on Table VI.

TABLE VI. REPORTS BY H. S. CARPENTER.

Date.	No. of the label on sample.	Appearance in 2 ft. tube.	Smell when heated to 100° F.	Microscopical examination.	Parts per 100,000.											—
					Chlorine in chlorides.	Phosphoric acid in phosphates.	Nitrogen.		Ammonia.	Albuminoid ammonia.	Oxygen absorbed in 15′ at 80° F. (26·6° C.)	Oxygen absorbed in 4 hrs. at 80° F.	Hardness.		Total solid matter dried at 220° F. (104·4° C.)	
							In nitrates.	Equivalent to nitric acid.					Before boiling.	After boiling.		
1883. May 11 -	250	Clear, very faintly yellowish.	None -	Very minute traces of vegetable débris.	10·60	None.	·0659	·2965	·0180	·0090	·0200	·0560	28·0	8·6	48·80	From the above results it appears that the amount of organic matter in this water is not great, the ammonias and oxygen absorbed being moderately low. The chlorine is somewhat high, but I am of opinion that in this case it is not indication of contamination with animal matter, and that some other source must be assigned for its origin. The amount of nitrates is small, and taking all the figures into consideration I consider that the organic matter is chiefly of vegetable origin, and that the sample is *a fairly satisfactory one* for domestic use.
" -	251	Clear and colourless.	None -	Minute traces of decayed vegetable matter.	74·5	Absent.	·6753	3·0388	·0220	·0010	·0280	·0600	65·60	39·60	195·80	This water contains a very large amount of chlorides, which must be looked upon as a *most objectionable feature*, although its significance is very considerably lessened by the small amount of the ammonias and oxygen absorbed, which would indicate that it is derived from some other source than pollution by excrementitious matters. The solids are extremely high, and its hardness makes it unsuitable for washing. On the *whole I cannot pass this as a satisfactory water for potable purposes.*
" -	252	Clear and colourless.	None -	Slight traces of vegetable débris.	13·40	None.	2·0670	9·3018	None.	·0040	·0600	·1480	50·60	24·50	135·88	The chemical examination of this water shows that it is one of moderate organic purity. The ammonias are low, and the oxygen absorbed appears to be due to a small quantity of vegetable matter, which is corroborated by the microscopical examination. There is a very considerable amount of nitrates, and the solids and chlorine are also higher than they should be. It *cannot* be looked upon as of first rate quality and recommended as a drinking water, although I should regard the risk of danger to health from its use as but slight.

,, -	253	Yellowish -	Very faint.	Small quantity disintegrated vegetable matter.	5·40	None.	·6835	3·0723	·0280	·0120	·0760	·1880	43·20	14·20	94·40	The above figures show that this water contains *too much organic matter to be regarded as perfectly safe*, though I am inclined to believe that it is chiefly of vegetable origin. Taking all the data into consideration, it *cannot be regarded as a satisfactory water for dietetic purposes.*
,, -	254	Clear, faintly yellowish.	None -	Satisfactory -	21·2	None.	1·5729	7·0782	·0950	·0080	·0680	·1680	45·70	20·10	94·00	This water contains a considerable amount of chlorides and nitrates, and the ammonia is high, the "albuminoid" ammonia being, on the other hand, comparatively low. The oxygen absorbed is also more than is desirable. Not knowing anything of the history of the sample, I am unable from a merely chemical examination to say whence the chlorine and ammonia are derived, and can therefore only remark that they are primâ facie objectionable features, and that *it is impossible to pass as satisfactory water containing these large amounts.*
,, -	255	Clear, yellowish.	None -	Small quantity amorphous mineral matter, minute traces vegetable débris.	14·10	None -	1·4988	6·7447	·0770	·0110	·1680	·3600	59·50	34·00	125·20	The above results show that this sample contains a considerable amount of free ammonia, the proportion of "albuminoid" being much less. The oxygen absorbed indicates that there is too large a quantity of organic matter and the nitrates and chlorides also make one *look upon this water with some suspicion.*
,, -	256	Clear, faintly yellow.	None -	Satisfactory -	10·10	None -	·6176	2·8382	None -	·0170	·1080	·2600	69·00	36·00	117·40	It appears from the above results that this is a water of moderate purity. The oxygen required is too great, but the ammonias are low. The chlorides of course are much too high for any normal water, but there appears to be some special cause other than animal contamination in this case. *I cannot say that this is a high class water altogether satisfactory for domestic purposes.*
,, -	258	Clear, very faintly yellow.	None -	Very slight, traces of vegetable débris.	13·50	None -	2·3470	10·5617	4·3600	·0400	·0840	·1840	64·30	30·8	121·40	This water is remarkable for the exceptionally large amount of ammonia it contains. In other respects, with the exception of the nitrates which are somewhat high, it calls for no special remarks except to say that the other results exhibit nothing like the proportion which one would expect from this excessive amount of ammonia, and that they negative the idea that it is derived to any considerable extent from sewage. *In its present condition it is quite unfit for use for domestic purposes, though it would appear to possess some value for land irrigation.*

Table VI.—*cont.*

Date.	No. of the label on sample.	Appearance in 2 ft. tube.	Smell when heated to 100° F.	Microscopical examination.	Parts per 100,000.											—
					Chlorine in chlorides.	Phosphoric acid in phosphates.	Nitrogen.		Ammonia.	Albuminoid ammonia.	Oxygen absorbed in 15′ at 80° F. (26·6° C.)	Oxygen absorbed in 4 hrs. at 80° F.	Hardness.		Total solid matter dried at 220° F. (104·4° C.)	
							In nitrates.	Equivalent to nitric acid.					Before boiling.	After boiling.		
1883. May 11 -	259	Slight turbidity, yellowish.	None -	Minute traces of vegetable débris.	5·50	None -	·2882	1·2971	·0230	·0040	·0720	·1520	44·50	15·60	66·60	I am of opinion, judging from the above results, that this sample is of fair organic purity, and *that it is tolerably well adapted for domestic use.* The small amount of organic matters present would appear to be of vegetable rather than of animal origin, and this opinion is confirmed not only by the microscopical examination, but also by the absence of phosphoric acid. *Although there are many waters of greater purity, I do not think the use of this is likely to be followed by deleterious consequences.*
„ -	260	Clear and colourless.	None -	Extremely minute traces of vegetable débris.	14·10	None -	1·9764	8·8941	·0010	·0060	·1000	·2160	52·50	27·20	130·20	This water appears to be of fair quality. The ammonias are low and the oxygens, although higher than they ought to be, are still not excessive. The *nitrates are high and so also is the chlorine,* but I am inclined to think there is some special cause for this latter, other than sewage contamination. There is a *considerable amount of solid matter,* more than I like to see, but taking all the results into consideration, I am of opinion that this sample is *fairly suitable for domestic and drinking purposes.*